INSTALLATION AND OPERATING INSTRUCTIONS

FOR

ONAN ELECTRIC GENERATING PLANTS

KB

SERIES

Onan®

DIVISION OF STUDEBAKER CORPORATION
2515 University Ave. S.E., Minneapolis, Minnesota 55414
IN CANADA: ONAN GENERATORS CANADA LTD., P.O. BOX 652, GUELPH, ONTARIO

957-2

Price $1.00

Printed in U.S.A.

We mean it.....

.....and this certificate with the Onan electric plant you purchased proves we mean it! When this plant left our factory in Minneapolis it took with it our sincere assurance that it will produce exactly as stated on its name-plate.

The name of ONAN is synonymous with satisfactory performance, certified performance.

GENERAL INFORMATION

This instruction book contains information for the proper installation, operation, and maintenance of your equipment. We suggest that this book be kept handy so that it can be referred to when necessary.

This equipment is the result of proven engineering design, highest quality materials, and expert workmanship. Thorough inspection and testing assures you that this equipment will perform as expected.

If you wish to contact your dealer or the factory regarding this equipment, be sure to supply the complete MODEL and SPEC. NO., and the full serial number of the equipment as shown on the nameplate. This information is necessary to identify the equipment among the many basic and special optional types manufactured.

MANUFACTURER'S WARRANTY

The Manufacturer warrants, to the original user, that each product of its manufacture is free from defects in material and factory workmanship if properly installed, serviced and operated under normal conditions according to the Manufacturer's instructions.

Manufacturer's obligation under this warranty is limited to correcting without charge at its factory any part or parts thereof which shall be returned to its factory or one of its Authorized Service Stations, transportation charges prepaid, within one year after being put into service by the original user, and which upon examination shall disclose to the Manufacturer's satisfaction to have been originally defective. Correction of such defects by repair to, or supplying of replacements for defective parts, shall constitute fulfillment of all obligations to original user.

This warranty shall not apply to any of the Manufacturer's products which must be replaced because of normal wear, which have been subject to misuse, negligence or accident or which shall have been repaired or altered outside of the Manufacturer's factory unless authorized by the Manufacturer.

Manufacturer shall not be liable for loss, damage or expense directly or indirectly from the use of its product or from any other cause.

The above warranty supersedes and is in lieu of all other warranties, expressed or implied, and of all other liabilities or obligations on part of Manufacturer. No person, agent or dealer is authorized to give any warranties on behalf of the Manufacturer nor to assume for the Manufacturer any other liability in connection with any of its products unless made in writing and signed by an officer of the Manufacturer.

DATED August 1, 1963

IMPORTANT

RETURN WARRANTY CARD ATTACHED TO UNIT

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The Onan generating plant of the KB series is a complete unit consisting of a spark ignition type engine, a self excited alternating current generator, and such controls and accessories as are specified by the purchaser.

The electrical characteristics of the plant are noted on the Onan nameplate. The power rating is for stand-by service. The plant is designed for automatic starting, load transfer, and stopping through optional line transfer and load demand controls. A 2-wire system is used for plant control.

If it ever becomes necessary to contact a dealer or the factory regarding the generating plant, be sure to mention the complete Model and Spec. No., and the Serial No. as given on the Onan nameplate. This nameplate information is necessary to properly identify the plant among the many types manufactured. Refer to the engine nameplate when requesting information from its manufacturer.

The generating plant is given a complete running test under various load conditions and is thoroughly checked before leaving the factory. Inspect the plant closely for any damage that might have occurred in shipment. Any such damage must be repaired before putting the plant in operation.

ENGINE

The engine is an International Harvester Co. basic model UV401 and is described in their Operator's Manual. The specific engine used may have variations due to optional features of the plant (type of fuel used, etc.) specified by the plant purchaser. Basically the engine is an 8-cylinder, V-design, water cooled, spark ignition type. The engine is rated 120-horsepower at 1800 rpm. The standard oil capacity is 10 U.S. quarts. 12-volt battery current is used for starting and control circuits, except on special models that require 36-volt cranking circuits. Accessories, safety devices, etc. vary according to the particular model and purchaser options.

GENERATOR

The generator produces alternating current as noted on the plant nameplate. The generator consists of a 4-pole revolving field type alternator and, except on special models, a "static" type exciter with magnetic amplifier regulation. The alternating current output is generated in the alternator stator winding attached directly to the rear end of the engine. The rotating field of the generator is attached to the engine flywheel, and so turns at engine speed. The speed at which the rotor turns determines the current frequency - thus the 60-cycle plant must operate at approximately 1800 rpm, and the 50-cycle plant at approximately 1500 rpm. The outer end of the rotor turns in a large ball bearing.

The stationary exciter is used on all models that use a separate automotive type starter and battery charging generator. The exciter components are mounted on a hinged frame attached to the alternator end bell, and are protected by a sheet metal

enclosure. The design of the exciter and regulator provides for voltage regulation of plus or minus 2% between no load and full load conditions. Stable generator output is established within 2 seconds after a change in load. The exciter has no moving parts, and requires no external voltage regulator.

The rotating exciter, used on special models designed to meet requirements of Pennsylvania, is a dc generator of 4-pole, revolving armature design. The dc output is used for exciting the alternator field. A separate ac voltage regulator is used. A series winding of the exciter permits its use as a permanently connected cranking motor. The exciter is attached to the outer end of the alternator, thus eliminating the necessity of drive belts, etc.

CONTROLS

Standard engine controls provide for electrically starting and stopping the generating plant at the control panel or at any one of several remote control stations. Remote control of plants effective with Spec H (Spec J for Penn. State) models is through a 2-wire system to a SPST customer-supplied switch. Models prior to Spec H (Spec J for Penn. State) are controlled through a 3-wire system to a SPDT, momentary contact switch. Safety devices used on all standard models include low oil pressure, high water temperature, and overspeed switches.

Standard generator controls differ between housed and unhoused models. Housed plants have a complete panel with a voltmeter, ammeter, running time meter, voltage rheostat, field circuit breaker, and voltage-current selector switch (3-phase models only). Unhoused plants have a voltmeter, circuit breaker, and a rheostat, but an optional meter panel, identical to the one used on housed models, is available.

The standard controls may be modified at the factory in accordance with customer specifications.

INSTALLATION

Installation of the generating plant involves its location, connection to a fuel source, exhaust system, starting battery installation, etc. Each installation must be considered individually - use these instructions as a general guide. A typical installation is shown, and by following the principles outlined and referring to the installation outline drawing supplied a proper installation can be made. Local regulations (building code, fire ordinance, etc.) may affect some details, and any such regulations should be fully observed.

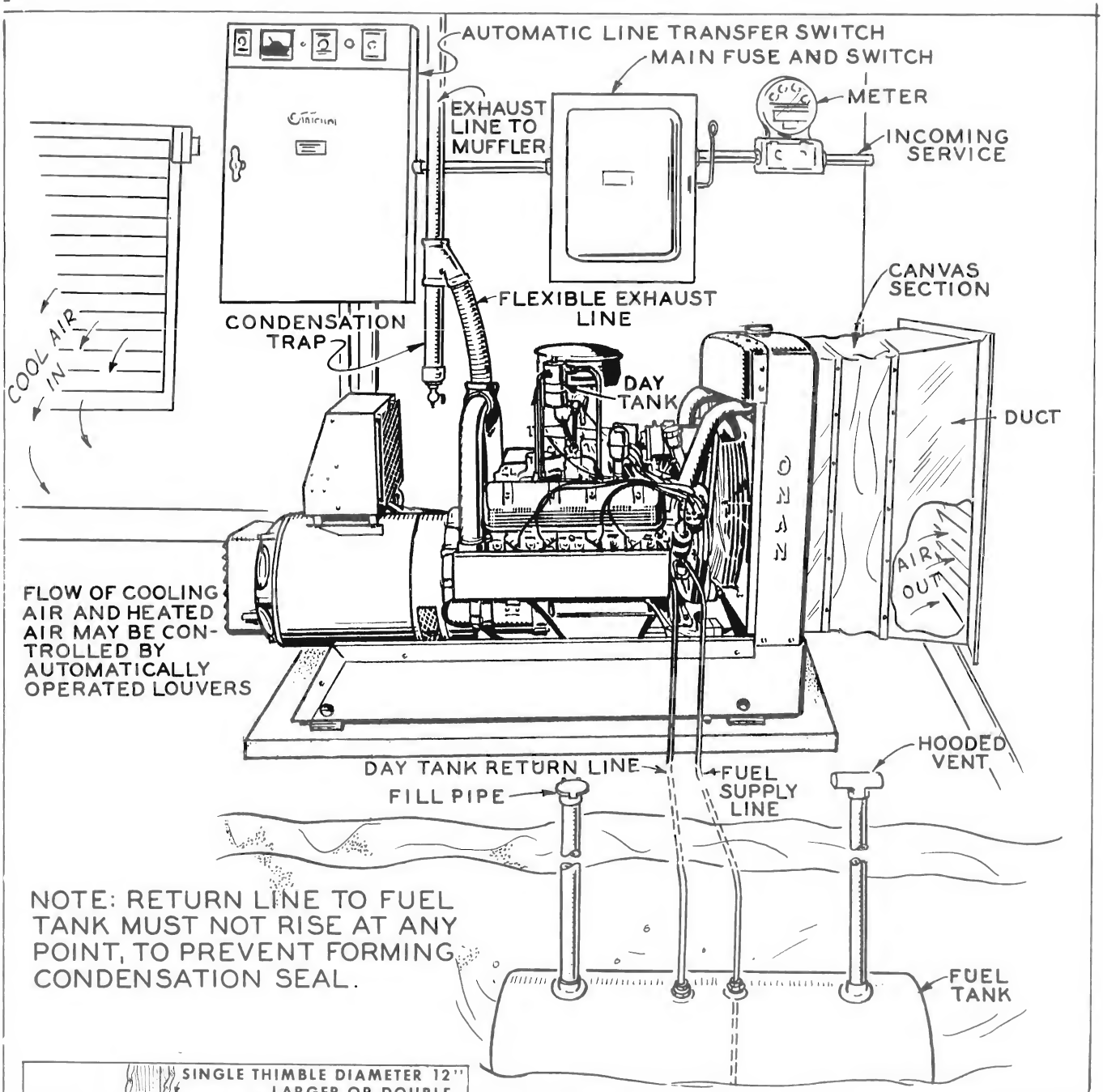
LOCATION. - Usually, the location has been pre-selected. For the average installation, a warm indoor site is recommended. Local regulations sometimes require that for emergency standby service the ambient temperature must not fall below a specified minimum. The selected site should be dry, well ventilated, and reasonably dust free. Provide for sufficient clearance (at least 24 inches) on all sides for convenience in servicing the plant.

MOUNTING. - The plant is mounted to a rigid base that provides proper support and adequate vibration damping. However, for convenience in draining crankcase oil, general servicing, etc., the plant can be mounted on raised pedestals or rails at least 6 inches high. Extra vibration dampers are available and may be installed under the plant base. If mounting in a trailer, or for other mobile application, bolt securely in place. For a stationary installation bolting down is optional.

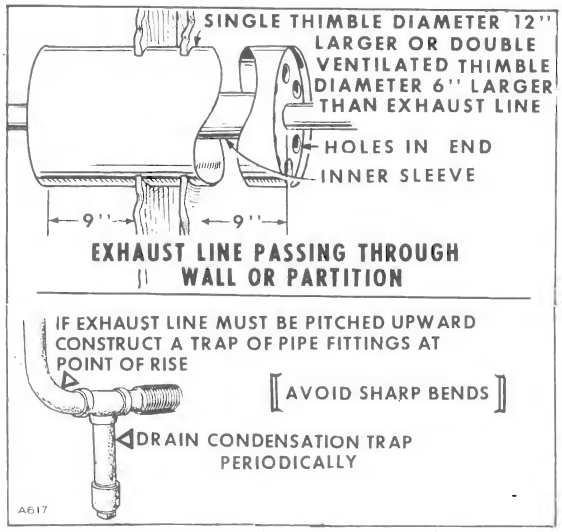
VENTILATION. - The engine generates a considerable amount of heat that must be dissipated. For a radiator cooled unit, proper ventilation is of vital importance. Under average operating conditions, a cooling air volume of approximately 11, 500-cubic feet of air per minute will provide sufficient cooling. If the installation is made in a small room, this may require installation of an auxiliary fan of sufficient size to assure proper volume of air. The fan can be connected to operate only when the plant is running. If the plant is equipped for "city water" cooling, an air volume of approximately 4, 000-cubic feet of air per minute will provide proper generator cooling and will support combustion in the engine.

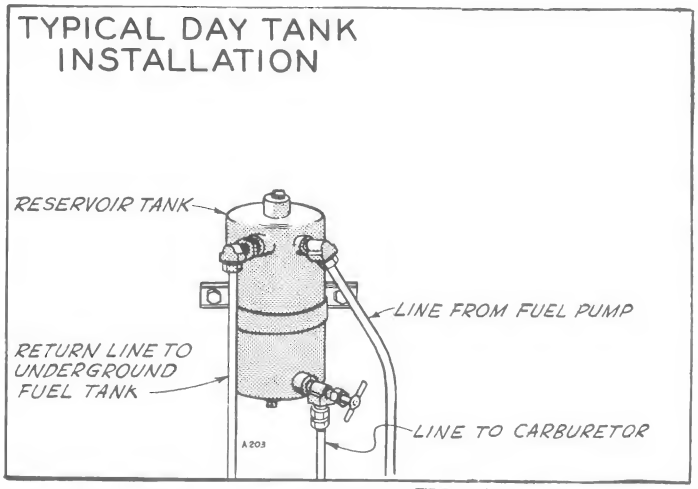
The pusher type fan used on radiator cooled units forces the cooling air out through the front of the radiator. For room or compartment installations the usual method of exhausting the heated air is to construct a duct from the front of the radiator to an opening in an outside wall. The duct and wall opening area should be at least as large as the plant radiator outlet area. An air inlet opening of at least equal area must also be provided.

Air inlet and outlet openings should be provided with suitable shutters to prevent back flow of cold outside air during shut down periods. Proper consideration must be given to any other draft creating equipment installed in the



NOTE: RETURN LINE TO FUEL TANK MUST NOT RISE AT ANY POINT, TO PREVENT FORMING CONDENSATION SEAL.





same room. If unattended, automatic starting (as for emergency standby with automatic line transfer switch) is planned, the shutters should be automatically controlled.

CITY WATER COOLING. - An optional method of engine cooling, in place of the conventional radiator and fan, uses a constant pressurized water supply. For piping connections, etc. refer to the separate outline drawing furnished. Variations of "city" water cooling are optional: the water may circulate directly through the engine, or the raw water may run through a heat exhanger which keeps the actual engine cooling liquid separate. The cooling water may also be used to cool the exhaust manifolds. An electric solenoid valve is installed in the water supply line, connected to open the water flow only when the plant is operating. A rate-of-flow valve (either automatic or hand adjusted) is recommended for installation in the supply line to control the water flow. Use flexible hose to connect water supply and outlet flow pipes to the engine connection points. Pipe the outlet flow to a convenient drain.

1. STANDPIPE SYSTEM. - The standpipe system uses a mixing, or tempering, tank. The cooling water that circulates through the engine mixes with a source of cool "raw" water. The "raw" water supply must be free of scale-forming lime or similar impurities.

2. HEAT EXCHANGER SYSTEM. - The heat exchanger installation provides for a "closed" engine cooling system. The engine coolant circulates through a tubed chamber, keeping the coolant separate from the cool "raw" water supply. The coolant chamber must be filled for operation, as for a radiator cooled plant. An electric solenoid valve is installed in the water supply line, connected to open the water flow only when the plant is operating. A rate of flow valve (either automatic or hand adjusted) is recommended for installation in the supply line to control the water flow. Use flexible hose to connect water supply and outlet flow pipes to the engine connection points.

EXHAUST. - Pipe the exhaust gases outside any enclosure. Use pipe at least as large as the 3-inch pipe size outlet of the engine. Increase the pipe diameter one pipe size for each additional 12-feet in length. Use a flexible connection at the engine exhaust manifold. Provide adequate support for the piping. Pipe fittings cause a resistance to the flow of exhaust gases and can result in a loss of engine power. Use sweeping type elbows in preference to standard pipe elbows, and keep the number of necessary turns to the minimum. If the exhaust line runs upward at any point, install a vapor trap at the low point, with provision for periodic draining. Shield or insulate the line if there is danger of personnel contact. Protect combustible walls and partitions through which the exhaust line passes with a metal thimble made to the approximate dimensions shown in the typical installation illustration on the adjacent page. Install a suitable muffler.

FUEL CONNECTIONS. - Check local regulations governing the installation of any fuel supply tank and supply lines. For gasoline fuel, an underground supply tank is usually specified. For gas fuel (natural or LPG) the fuel supplier should be consulted as to the necessity of pressure regulators, filters, etc. auxiliary to those supplied with the plant. Local conditions must be considered.

Gasoline Fuel. - The fuel pump on the engine has the inlet opening threaded for a 1/4-inch pipe thread fitting. Proper adapter fittings must be used to connect the supply line. Any air leak in the supply line will prevent pumping of fuel. Maximum fuel pump lift is approximately 6-feet.

The engine may be equipped with a 1-quart reservoir tank to replenish fuel lost from the carburetor by evaporation during shut down. Connect a 5/16" fuel return line between the reservoir upper side fitting and the main supply tank. Be sure the return line has a continuous drop to the supply tank, with no dip-and-rise where fuel could collect and form a vent seal. See that the top center opening of the tank is tightly plugged.

LPG Fuel. - The liquefied petroleum gas fueled plant is equipped with a heat exchanger system, combined with the pressure reducing regulator. Use only approved materials and methods to connect to the supply source. Install a liquid type fuel filter in the supply line, and an electric solenoid valve. Refer to the engine control wiring diagram for solenoid valve connections. An emergency hand shut-off valve should be provided.

Natural or Manufactured Gas. - The regulator supplied for use with natural gas is designed for a line pressure of 7-to 10-inch water column (maximum of 6-oz. per square inch). If the line pressure exceeds 6-oz., a primary pressure reducing regulator must be installed in the supply line. Install an approved fuel filter in the supply line, ahead of the pressure regulator. Install an electric solenoid valve in the supply line, and connect as shown on the engine control wiring diagram.

Combination Gas-Gasoline. - The combination gas-gasoline plant is designed for normal operation on gas fuel, with provision for emergency operation on gasoline fuel. Follow the appropriate fuel connection instructions.

BATTERY. - Some plants use a separate automotive type starter and battery charging generator. Connect the battery POSITIVE to the starter solenoid, and the battery NEGATIVE to ground. Do not reverse these connections. The standard plant, as noted on the nameplate, uses a 12-volt battery (type 3EM).

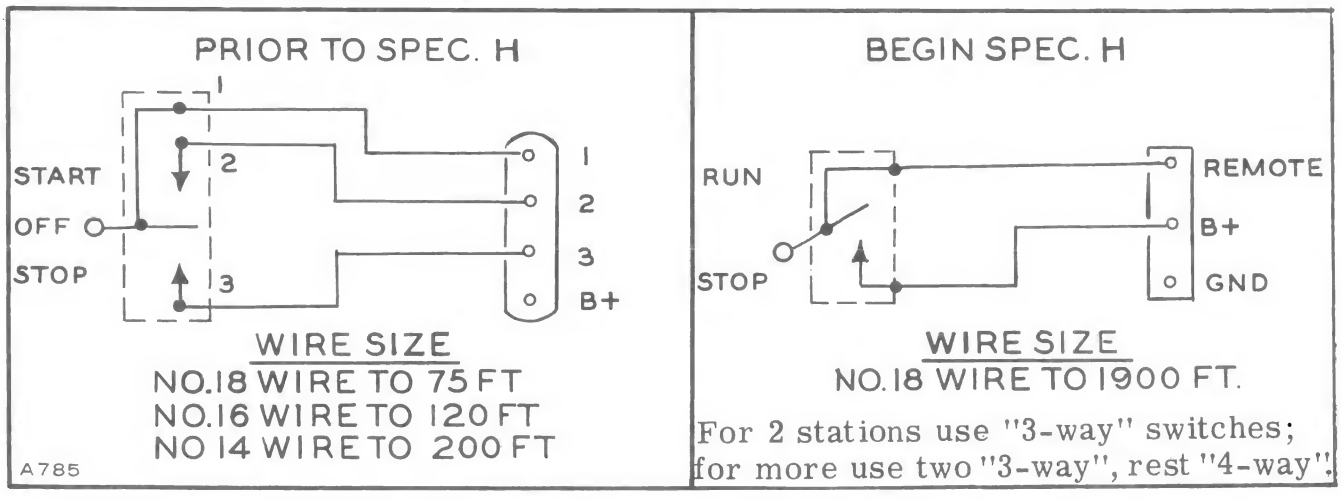
Plants that have exciter cranking use the generator exciter as a cranking motor. Three 12-volt batteries (or six 6-volt batteries) must be connected in series to provide the 36-volt cranking voltage. Connect the battery positive to the start solenoid switch, and the battery negative to the exciter frame ground.

The plant includes a battery charging circuit that keeps the battery charged in normal service. However, if the plant is used infrequently, as in standby service, operating periods may be of short duration or infrequent enough to allow the battery to self discharge. A separate trickle charger should be connected for such installations. Onan automatic load transfers include such a charging circuit.

ENGINE HEATER. - The function of the optional engine heater is to keep the engine warm enough to assure starting automatically under adverse temperature conditions. Connect the heater to a source of power that will be on during the time the plant is not running. Be sure the voltage is correct for the heater element rating.

REMOTE CONTROL CONNECTIONS. - Effective with Spec H plants (Spec J for Penn. State), starting and stopping is through a 2-wire electrical system. To extend this control to one or several remote locations, a 3-place terminal block is provided in the plant control box. The terminal block is marked REMOTE, B+, and GND. If a load transfer or an automatic control is used, follow the instructions supplied with the control. If a SPST manual switch is used, connect the wires and mount the switch so the engine will run when the switch handle is up, the same as an ordinary light switch. The size wire to use is determined by the plant-to-control distance. Use #18-wire up to 1900-feet. The GND terminal is for a customer-supplied alarm at a remote location to warn of low oil pressure, high water temperature and overspeed.

Plants prior to Spec H (Spec J for Pennsylvania) are controlled through a 3-wire system from a 4-place terminal block in the plant control box. Use a single-pole, double-throw, momentary contact switch. Make connections as shown in the illustration.

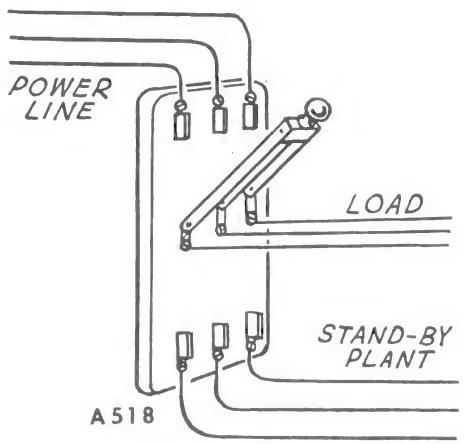


OPTIONAL ALARM. - The GND terminal on the remote terminal block is for a customer-supplied alarm at a remote location to warn of low oil pressure, high water temperature, and overspeed. These conditions are indicated at the plant by a light on the control panel. Refer to the wiring diagram for the proper voltage.

CONNECTING LOAD WIRES. - The generator output leads terminate inside the sheet metal box on the generator. Knock out openings are provided for bringing in the load wires.

Observe requirements of electrical codes in effect at the installation site. Most local regulations require that the wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation.

If the installation is for standby service, a double throw transfer switch MUST ALWAYS be used. This switch (either manual or automatic type) must be connected so that it is impossible for the generator output to be fed into the normal power source lines, or for normal source and generator output to be connected to the load at the same time. Instructions for connecting an automatic load transfer switch are included with such equipment. It is assumed that personnel connecting the generator, and any auxiliary equipment, are fully qualified and understand the problems of balancing the circuits, grounding the plant, etc. Refer to the output control wiring diagram furnished. Note that each generator lead is marked as noted on the wiring diagram.

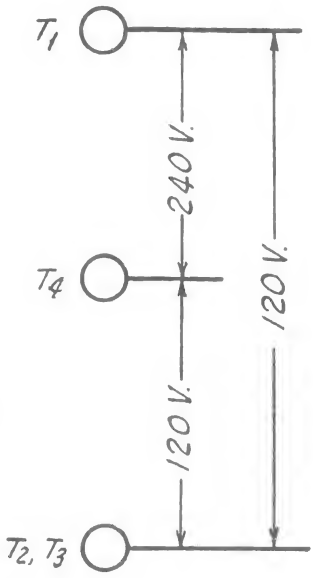


120/240-VOLT, 1-PHASE

Note that the lead marked T2, T3 is grounded. This is the neutral lead for 120-volt service. Leads T1 and T4 are the "hot" leads, providing two 120-volt circuits, with up to 1/2 the plant rated capacity available on each circuit.

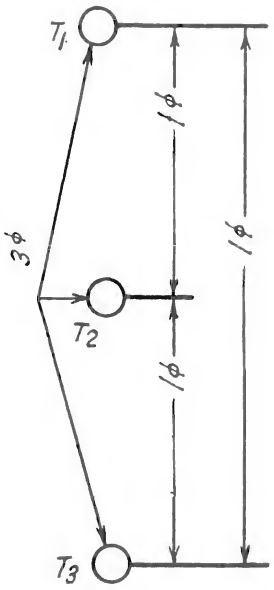
For 240-volt service, connect one load wire to the T1 lead, and the second load wire to the T4 lead. Lead T2, T3 is not used for 240-volt service.

If both 120-volt and 240-volt current is to be used at the same time, use care not to overload either circuit.



INSTALLATION

3-PHASE, 3-WIRE



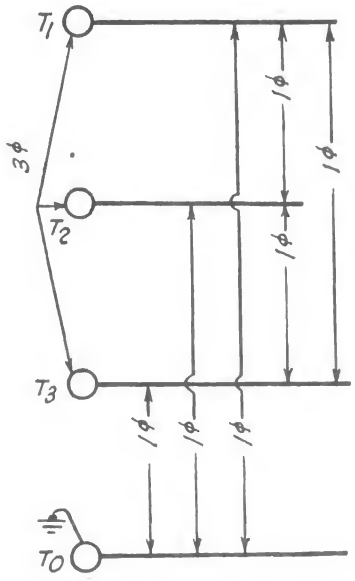
No lead is grounded, each pair of leads serving as one "leg" of the three phase circuit. Connect a separate load wire to each generator lead T1, T2, and T3.

If phase sequence is important, as with 3-phase motors, final connections may be postponed until a trial run is made. If the plant is installed for standby service, phase sequence of the normal line service and the generator output must be the same, for proper load operation.

Single phase current is obtained from any two output leads, T1-T2, T1-T3, or T2-T3. However, the load connected to any one single phase circuit must not be greater than 1/3 the rated capacity of the plant.

If both single and three phase service is to be used at the same time, use care not to over load any one circuit. Subtract the amount of the 3-phase load from the rated capacity of the plant. Divide the remainder by 3, and this is the maximum load that can be connected to any one single phase circuit.

3-PHASE, 4-WIRE, Y-CONNECTED



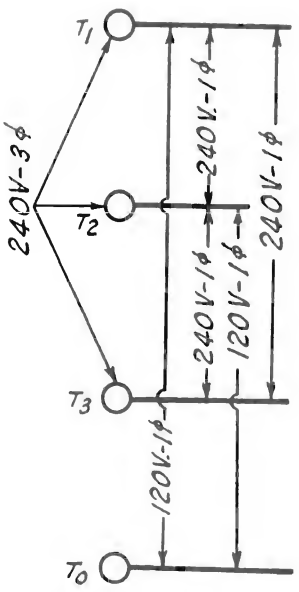
The 3-phase, 4-wire plant produces single-phase current of one voltage, and three phase current of a different voltage. The single phase voltage is the lower voltage as noted on the plant nameplate, and the three phase voltage is the higher nameplate voltage.

The lead marked T0 is the grounded lead for single phase service. Connect the single phase load neutral wire to the T0 generator lead. Connect the "hot" load wire to any one of the other three leads T1, T2, or T3.

For three phase service, connect the separate load wires to the three generator leads T1, T2, and T3. If phase sequence is important, refer to the principles of connection as given for the 3-phase 3-wire plant. If single phase and three phase current is to be used at the same time, use care to properly balance the load, as explained for the 3-wire plant.

120/240-VOLT, 3-PHASE, 4-WIRE DELTA CONNECTED

The 3-phase DELTA connected plant is designed to supply 120-volt single phase service and 240-volt three phase service. The lead marked T0 is the generator center tap between T1 and T2, and is normally not grounded.



For 240-volt 3-phase service, connect the three load wires to the three generator leads T1, T2, and T3 - one wire to each. The T0 lead is not used for 3-phase service. If phase sequence is important, refer to the principles of connection as given for the 3-wire plant.

For single phase service, leads T1 and T2 are the "hot" leads. The T0 lead is the neutral, which can be grounded if required. For 120-volt service, connect the "hot" load wire to either the T1 or T2 generator lead. Connect the neutral load wire to the T0 generator lead. Two 120-volt circuits are available. 240-volt single phase current is available between leads T1 and T2.

Any combination of single phase and three phase loading can be used at the same time as long as the current for anyone output lead does not exceed the nameplate rating of the generator.

CRANKCASE OIL. - Fill the crankcase (capacity 10 U.S. quarts) with a good quality oil of the SAE number recommended for the temperature conditions. Refer to the engine manual. Most oils that are marketed for MS or DG service meet requirements of MIL-L-2104A.

AIR CLEANER. - Service the air cleaner with oil, filling to the level marked on the cleaner. Use the same SAE number as used in the crankcase. However, if air cleaner oil renewal is likely to be frequent, it is not necessary to use expensive heavy duty oil in the air cleaner. A straight non-detergent mineral oil is satisfactory.

COOLANT. - For a radiator cooled plant, fill the radiator with clean soft water. Use a good rust and scale inhibitor. If there is any possibility of freezing, use a standard antifreeze in the recommended proportion. The approximate capacity of the radiator cooled plant is 10 U.S. gallons. On the initial run, check the level several times and add liquid as necessary to compensate for any air pockets which may have formed when filling.

If the plant is equipped for "city" water cooling, see that the water supply to the engine is turned on. If the system is the "closed" or heat exchanger type, see that the chamber portion is properly filled, similar to a radiator equipped unit. Make a preliminary adjustment of the water flow as indicated in the table. Make final adjustment after the plant warms up.

MINIMUM WATER FLOW - HEAT EXCHANGER COOLING

ELECTRICAL LOAD	WATER TEMP.	MIN. FLOW-GAL/MIN.
50 KW	40°F.	13.3
	60°F.	16
	80°F.	20
60 KW	40°F.	13.3
	60°F.	16
	80°F.	20

MINIMUM WATER FLOW-TEMPERING TANK COOLING

ELECTRICAL LOAD	WATER TEMP.	MIN. FLOW-GAL/MIN.
50 KW	40°F.	6.1
	60°F.	7.25
	80°F.	9.1
60 KW	40°F.	7.1
	60°F.	8.5
	80°F.	10.7

FUEL. - If the plant is to use gasoline fuel, see that the fuel supply tank is properly filled with automotive "regular" gasoline. Do not use highly leaded premium grade gasoline.

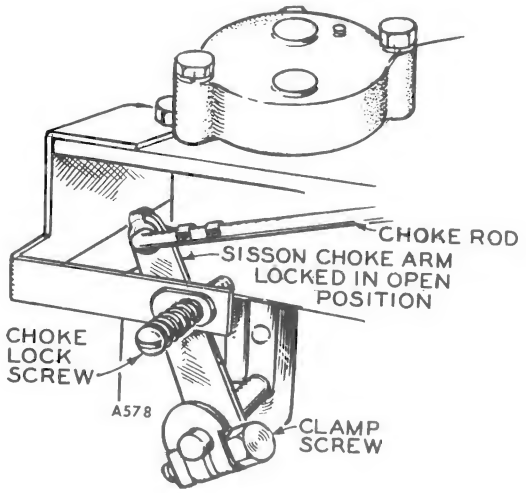
If the plant is equipped for gas fuel, see that the fuel supply is turned on. Observe all safety precautions regarding the use of gas fuel. Refer to the engine manual.

COMBINATION GAS-GASOLINE FUELED PLANT. - A plant designed for normal operation on gas fuel, with provision for emergency operation on gasoline fuel, is equipped with a GAS-GASOLINE toggle switch. Throw the switch to the appropriate position, according to the type of fuel in use.

1. Plants prior to model number ending with Spec Letter E. - When the toggle switch is at its GAS position, normal choking for starting is provided. When the switch is at its GASOLINE position, the manual choke provided requires personal supervision for starting.

2. Plants beginning at Spec Letter E. - When the toggle switch is at its GAS position, the electric choke is disconnected, and must be mechanically locked to make it inoperative. Proper choking action for gas operation is provided by an off-set weight on the carburetor choke shaft.

For gas operation, pull the arm away from the carburetor and turn the lock screw in far enough to prevent the arm from returning to its gasoline operating position. The screw must pass over the edge of the arm, as shown.



For gasoline operation, the arm locking screw must be backed out far enough to release the choke arm.

STARTING. - For the initial start, and at other times when practical, start the plant without a load connected by moving the circuit breaker to the OFF position.

To start the plant, move the run-stop switch handle to the RUN position and leave it there. Choking is automatic. When the engine comes up to speed, cranking will automatically stop. If the engine fails to start within 30 seconds, the cranking limiter will trip and cranking will stop. If overcranking occurs on the initial start,or after the engine has run out of fuel, wait for 1-minute before resetting the cranking limiter, and then re-attempt the start. If the engine fails to start a second time, inhibitor oil sprayed into the cylinders at the factory may be the cause. Remove, clean, and thoroughly dry each spark plug.

CHECKING OPERATION. - When the engine starts, immediately check the oil pressure gauge and charge ammeter. As the engine warms up, check the water temperature gauge. When the oil pressure stabilizes, move the circuit breaker to the ON position and check the generator output gauges. The output voltage will be a few volts higher than rated voltage under full load until the generator warms up. If at that time the voltage is above or below rated voltage, make a compensating adjustment with the rheostat on the control panel.

If an automatic load transfer control is installed, check its operation carefully. See that any auxiliary equipment is functioning properly in relation to the entire installation.

STOPPING. - If practical, disconnect the electrical load before stopping the plant, and then let the plant run for a few minutes to cool the engine and generator. To stop the engine, move the run-stop switch to STOP.

EXERCISE PERIOD. - A plant used for emergency standby service may stand unused for extended periods. To insure prompt starting, and to keep oil distributed on engine parts, the plant should be given an exercise run of 15 to 30 minutes every few days. Optional equipment is available to provide such an exercise period automatically.

NORMAL OPERATING FUNCTIONS

Operating controls vary according to the particular model, and purchaser options. Normal operating functions of the most commonly supplied equipment are described.

OIL PRESSURE. - The oil pressure gauge registers the engine operating oil pressure. Investigate immediately any sudden change in the oil pressure.

WATER TEMPERATURE GAUGE. - The water temperature gauge indicates the engine coolant temperature during operation. Normal operating temperature is approximately 160^{o}F. to 190^{o}F.

CHARGE AMMETER. - The dc ammeter indicates the battery charging current. An automatic regulator controls the charging rate, according to the charge condition of the battery.

PUSH TO RESET BUTTON. - The reset button is in the emergency latch relay circuit. If one of the plant safety devices operates to stop the plant, the reset button must be pushed in before the plant can be re-started.

RUNNING TIME METER. - The running time meter registers the total number of hours, to 1/10, that the plant has run. It provides a reference for checking periodic service, etc.

AC AMMETER. - The ammeter indicates the amount of load connected to the generator. On three phase models, the meter reading indicates the current for one "leg" only, as determined by the selector switch position. Single phase models may have two meters, one for each circuit, with no switch.

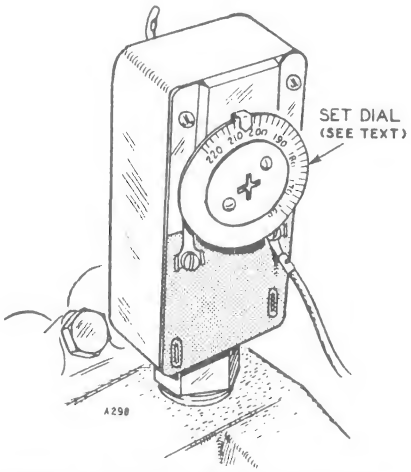
AC VOLTMETER. - The voltmeter indicates the ac output voltage. On single phase models, only the higher nameplate voltage will be shown. On three phase, four wire models, only the three phase (higher) nameplate voltage will be shown. The meter reading for three phase models will be for the same phase as the ammeter reading, as determined by the selector switch position.

SELECTOR SWITCH. - The meter selector switch is a rotory type switch. Its position determines which phase, on three phase plants, of the generator output is shown on the ammeter and voltmeter.

CIRCUIT BREAKER. - The circuit breaker protects the plant against severe over loads. If the breaker operates, it must be reset manually.

SAFETY DEVICES. - Various safety devices may be installed, either to warn of improper operation or to automatically stop the plant under conditions that could cause severe plant damage. For some models, these devices are purposely not supplied - the plant is intended to continue running under the most adverse conditions in an extreme emergency.

1. High Water Temperature Switch. - The switch operates to stop the engine if the coolant temperature rises too high. This prevents overheating which would cause serious damage to the engine. The engine may be started again when the temperature drops about 10^{o}. (1) Adjustable temperature switch



HIGH WATER TEMPERATURE
CUT-OFF SWITCH
(EARLY MODELS ONLY)

used prior to early models was set at the factory at 205°. The dial adjustment should be set at a temperature several degrees below the boiling point of the coolant. Lower the setting 3° for each 1000feet above sea level. Do not set the switch to operate at too low a temperature or the engine may be stopped before it reaches operating temperature. (2) Non-Adjustable switch used on later models is fixed to operate at 202°F. plus or minus 2°.

2. Low Oil Pressure Switch. - A pressure operated switch mounted on the engine stops the plant if the oil pressure fails. The switch is not adjustable.

3. Overspeed Cut-off. - A centrifugal weight type switch is attached to the outer end of the generator shaft and is not adjustable. The switch operates to stop the plant if the engine speed should accidentally rise to a dangerous point. Under no circumstances should the plant be operated if the switch is disconnected or otherwise made inoperative. Excessive speed could cause extensive generator damage.

If the switch stops the plant, check the governor system to make sure it is adjusted correctly and operating freely. If the governor is correctly adjusted and engine is otherwise functioning properly, the plant still shuts down, the switch may not be operating properly. Do not attempt to adjust the switch, replace with a new one.

NOTE

If one of the safety devices operates to stop the plant, the emergency stop relay PUSH TO RESET button must be pressed in before the plant can be restarted.

VOLTAGE REGULATOR RHEOSTAT. -

NOTE

Plant models that end with spec. letter A and having the "static" (stationary) type exciter are not equipped with a voltage regulator rheostat. If voltage adjustment is necessary, refer to the MAINTENANCE section.

The voltage regulator rheostat provides for adjusting the ac output voltage for normal operating conditions. It provides an adjustment range of 5% plus or minus if the engine governor is properly adjusted. Turn clockwise to increase the voltage, counterclockwise to lower the voltage. The voltage regulator should keep the output voltage within 2% plus or minus between no load and full load. It should not be necessary to change the regulator rheostat setting, once set, for normal operation.

FIELD RHEOSTAT AND VOLTAGE REGULATOR SWITCH. - The combination field rheostat and switch is used only on those plants that have the dc generator type exciter. It provides for emergency manual voltage control in the event of accidental failure of the separate voltage regulator.

When the field rheostat is turned to its extreme counterclockwise position, a built in switch provides for voltage regulator operation. When the field rheostat is turned slightly clockwise, the built in switch cuts out the automatic voltage regulator and the output voltage must be manually controlled by the field rheostat. Any substantial change in the electrical load will require a compensating re-adjustment of the field rheostat. Turn clockwise to increase the voltage, counterclockwise to lower.

TACHOMETER. - The tachometer indicates engine speed in revolutions per minute. It is useful in checking engine performance. Generator output frequency can be calculated from engine speed: divide engine speed by 30 (example - 1830 rpm speed results in 61 cycles generator output frequency).

FREQUENCY METER. - The frequency meter indicates the frequency of the output current in cycles per second. Engine speed can be calculated from frequency: multiply frequency by 30. For example - 61 cycles x 30 results in 1830 rpm.

BATTERY, HOT LOCATION. - A storage battery will self discharge very quickly when the ambient temperature is consistently above 90°F., such as in a boiler room. To lengthen battery life under such conditions, dilute the battery electrolyte from its normal 1.275 specific gravity reading at full charge to a 1.225 reading. The cranking power of the battery will be reduced slightly when the electrolyte is so reduced, but if the temperature is above 90°F., this should not be noticed, and the lengthened battery life will be a distinct advantage.

1. Fully charge the battery.
2. With the battery still on charge, draw off all the electrolyte above the plates in each cell. DO NOT ATTEMPT TO POUR OFF! Use a hydrometer or filler bulb. Avoid dripping and dispose of the electrolyte in a safe manner.
3. Refill each cell with approved water, to the proper level.
4. Continue charging for one hour at 4 to 6 ampere rate.
5. Test each cell. If the specific gravity is still above 1.225, repeat steps 2, 3 and 4 until the reading is reduced to 1.225. Usually, repeating steps two times is sufficient.

PENNSYLVANIA STANDBY. - Plants designed to requirements of Pennsylvania for standby use are normally supplied with an automatic load transfer switch. Some of the pertinent features of such plants are listed below.

The plants use 36-volt battery current and exciter cranking - not a separate automotive starter.

No "safety" engine stopping devices are used - the plant is intended to supply emergency power under even the most adverse operating conditions.

The starting battery charge circuit is incorporated in the load transfer control.

Gasoline fueled plants are equipped with the fuel reservoir tank. Gas fueled plants have the electric solenoid valve in the gas supply line.

No output circuit breaker is used.

GENERAL. - Follow a definite schedule of inspection and servicing. Keep an accurate record of operating time, and servicing operations performed. Service periods are based on normal service and operating conditions. For continuous heavy duty, extreme temperatures, or other unusual operating conditions, service more frequently. For light duty, periods of little use, etc., service periods may be lengthened accordingly.

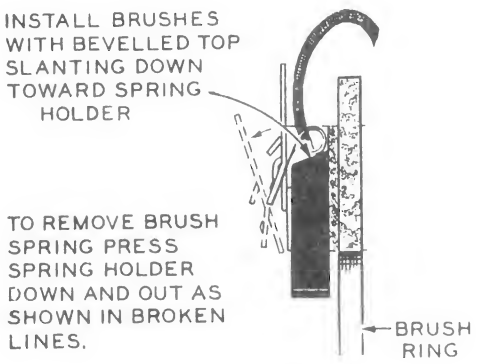
ENGINE. - Refer to the International Harvester manual for recommended inspection and service procedures. Follow the schedule as it applies to the particular unit.

AC GENERATOR. - At intervals of 200 hours to 250 hours, to coincide with scheduled engine servicing, check the condition of the generator. In normal service, the generator slip rings acquire a glossy brown surface. Do not attempt to maintain a bright, newly machined appearance. Normal cleaning can be performed with a dry, lint free cloth or light canvas. Slight roughness can be remedied by lightly sanding with #00 sandpaper. Blow out all sanding and brush dust.

On units using the dc generator exciter and separate voltage regulator, service the dc commutator in the same manner as the slip rings.

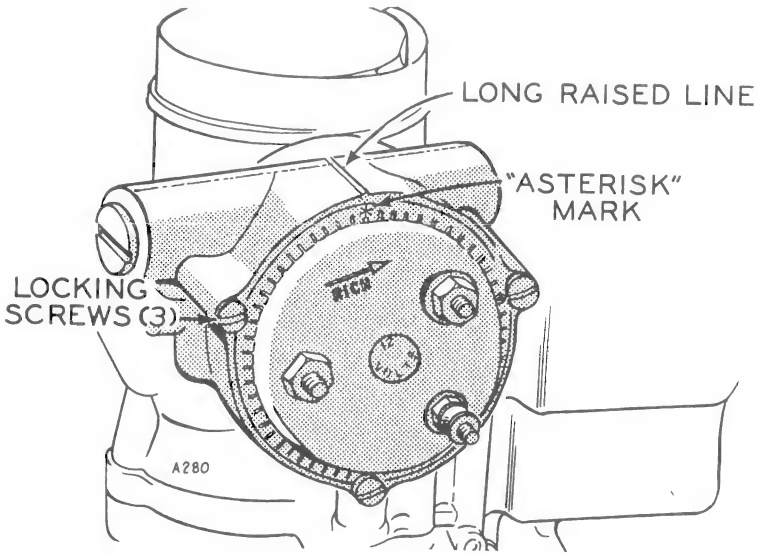
See that brushes ride freely in their guides, and make proper contact. Replace brushes when worn to 1/2 inch in length, or if chipped or otherwise damaged. Note that it is necessary to remove each brush spring and plate before its brush can be removed. The spring will be kinked and damaged if the brush is pulled out past the mounted spring.

Some brushes are tapered at the wire lead end. The short side of the taper must face toward the spring and its plate. New brushes are contoured to fit without sanding but may require a short run in period of operation before full load is applied to the generator.



BRUSH SPRING REMOVAL

GASOLINE (ONLY) CARBURETOR CHOKE. - The carburetor designed for gasoline (only) fuel is equipped with an electrically heated choke. A heating element inside the choke cover acts upon a bi-metal thermal coil to turn the choke shaft and valve. The outer edge of the choke cover is divided into small sections by raised marks, one of which is emphasized by an asterisk (*). A long raised mark on the top of the choke housing is used as a reference mark. The normal setting is made with the * mark aligned with the reference line. If adjustment is necessary, loosen the cover locking screws and turn the cover - clockwise for more choking action, counterclockwise for less choking. Turning one or two marks is usually sufficient. Retighten the cover screws.



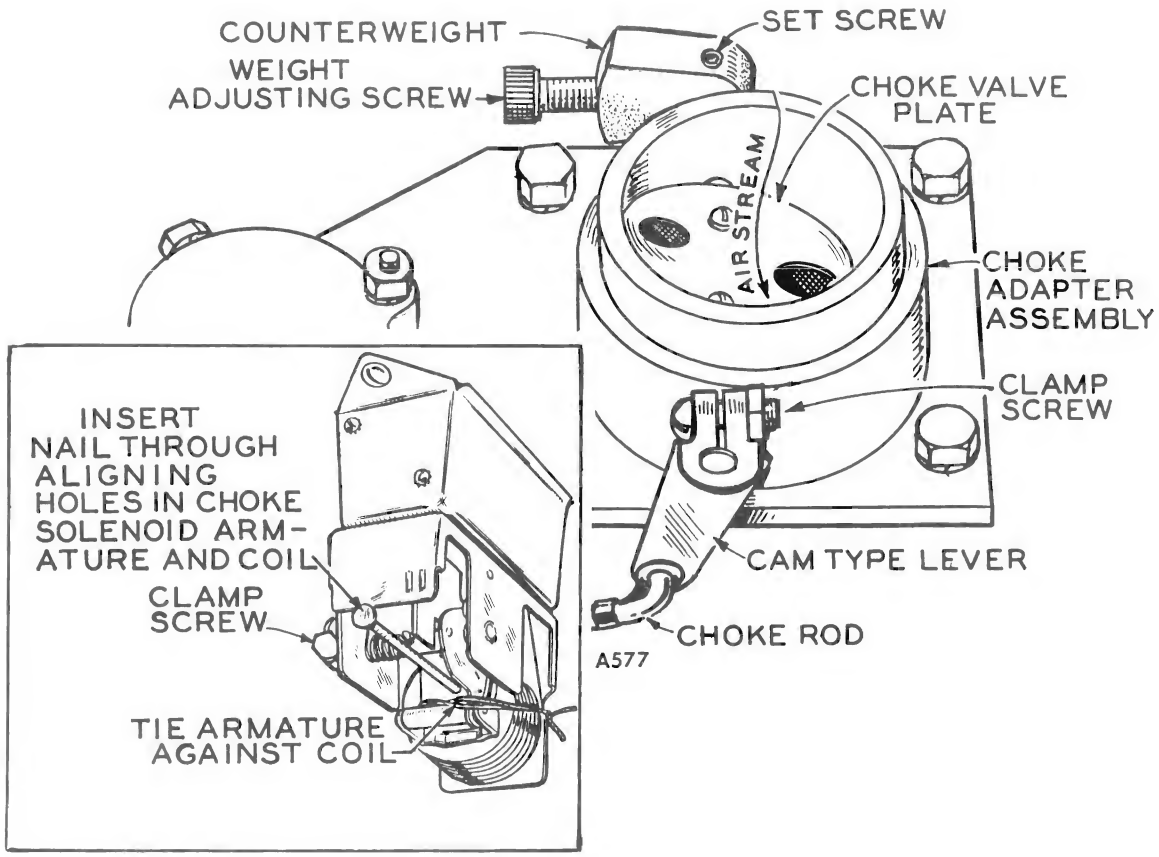
If this type choke is used with gaseous fuel, the cover is normally turned 12 marks counterclockwise to make it inoperative.

SISSON CHOKE. - The Sisson automatic choke is used on some combination gas-gasoline fueled plants. For gas fuel (see OPERATION), the Sisson choke arm is locked to make it inoperative - an off-set weight on the carburetor choke shaft provides the slight choking necessary.

1. Gas Operation. - A difference in the BTU content of the gas may necessitate an adjustment of the counterweight socket head screw. For high BTU gas, turn the screw in to provide less choking. For lower BTU gas, turn the screw outward to provide more choking action.

2. Gasoline Operation. - The arm lock must be released to allow proper choke action. The choke linkage over-rides the weight action, providing for full choking for cranking, and gradual opening during warm-up. Extremes in ambient temperatures should not necessitate readjustment. However, if the original factory settings have been disturbed, those settings must be properly restored.

a. Remove the air cleaner, to observe the action of the choke plate.



b. Remove the snap-on cover of the Sisson choke body.

c. Position the off-set weight on the shaft so that, with the choke plate held closed, the top edge of the weight is horizontally level. Use the small set screw to lock the weight in position on the shaft.

d. Loosen the lever clamp screws on the carburetor choke and the Sisson mechanism just enough to allow adjustment on their shafts.

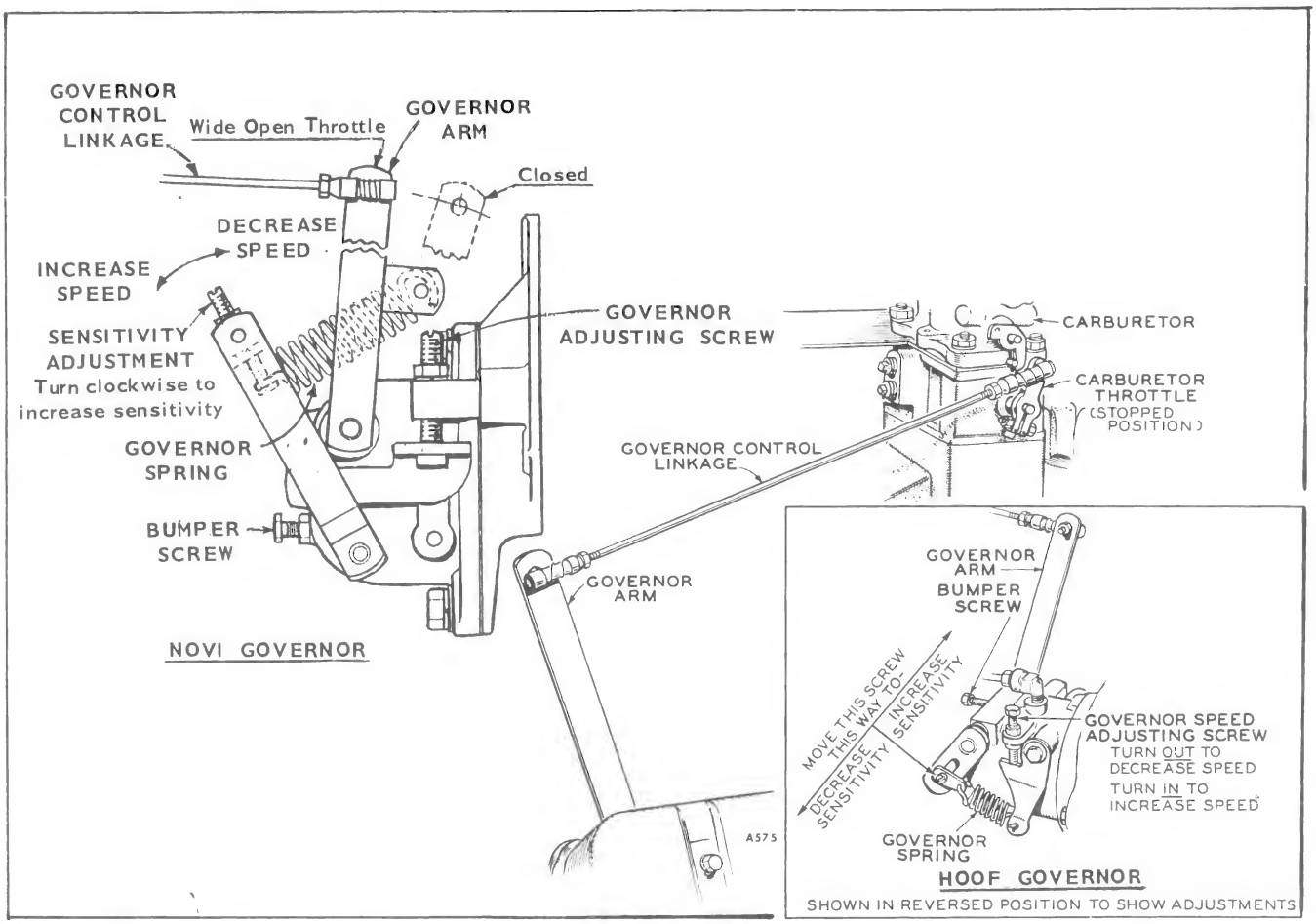
e. Insert an 8-penny nail or similar 1/8-inch diameter rod through the aligning holes of the solenoid armature and core. Tie the armature firmly against the core. This simulates the choke position while the engine is cranking.

f. With the carburetor choke plate held closed, tighten the Sisson arm on its shaft in a perpendicular position. Turn the carburetor choke clamp lever clockwise just to the point of contact with the over-ride cam lever. Tighten the clamp screw, with the choke plate still closed.

g. Remove the alignment nail and untie the armature. Check for proper operation. With the Sisson choke arm locked in position for gas operation the choke plate should close fully (from the counterweight action) but should be free to blow completely open from air stream action. Make any necessary corrections in the adjustments.

GOVERNOR ADJUSTMENT. - The governor controls the engine speed, and therefore the frequency of the generator output current, under various load conditions. Either a tachometer or frequency meter can be used to check engine speed for proper governor adjustment. Each 30 rpm engine speed is equivalent to 1-cycle current frequency: 1830 rpm produces 61 cycle output frequency.

> Before making a governor adjustment, the plant should be run long enough to thoroughly warm up. The carburetor must be adjusted for proper fuel ratio - either a too rich or a too lean fuel adjustment can cause loss of power and erratic governor action.



ADJUSTMENTS

1. With the plant stopped, see that the linkage between the governor arm and the carburetor throttle is adjusted to proper length, for fully open carburetor position.

2. See that the governor "bumper" screw is backed off far enough to make it temporarily inoperative.

3. With no electrical load connected, adjust the speed adjusting screw to obtain a speed of no more than 1890 rpm (63 cycles) for a 60-cycle plant. For a 50-cycle plant the maximum speed is approximately 1590 rpm (53 cycles).

4. Apply a full electrical load. The speed drop from the no load figure should be no more than 90 rpm (3 cycles) but should be at least 45 rpm (1-1/2 cycles). If speed drop is excessive, increase the sensitivity as illustrated. If the plant tends to alternately increase and decrease speed (hunt), decrease the sensitivity. Any change in the sensitivity adjustment will require a slight compensating adjustment of the speed screw.

5. Check the output voltage, which should be adjustable within 5% of the rated voltage by means of the control panel rheostat. If necessary, adjust the speed screw, but keeping the speed within the no load limit of 1890 rpm (63 cycles) for a 60 cycle plant, and full load speed of 1770 rpm (59 cycles) with the preferred difference of about 60 rpm (2 cycles).

6. After satisfactory operating adjustment is made, remove the electrical load and turn in the bumper screw just to the point of causing a slight speed increase. Back the bumper screw off 1/2-turn.

7. Be sure that the lock nuts on the speed adjusting and bumper screws are tightened, to prevent any change in the settings from vibration.

ENGINE. - Refer to the International Harvester manual for details of engine maintenance. Note, however, that the engine electrical system described therein does not apply - refer to the Onan wiring diagram instead.

Anti-dieseling Control. - The anti-dieseling control is a device to close the throttle during stopping of the plant. It counteracts the tendency of the governor to pull the throttle open as plant speed drops, and possible compression firing. The control spring tension must be sufficient to overcome the governor jointed lever spring but weaker than the pull of the solenoid.

GENERATOR. - The generator normally requires very little maintenance other than the periodic inspection service.

Generator Bearing. - The generator ball bearing is pre-lubricated and sealed. It requires no maintenance during its service life.

EXCITER. - The "static" exciter and regulator is used on units that have the separate automotive type starter and charging generator.

The exciter has no moving parts. Occasionally blow out any dust, etc. Check thoroughly to assure that all components are mechanically secure, and that all electrical connections are tight.

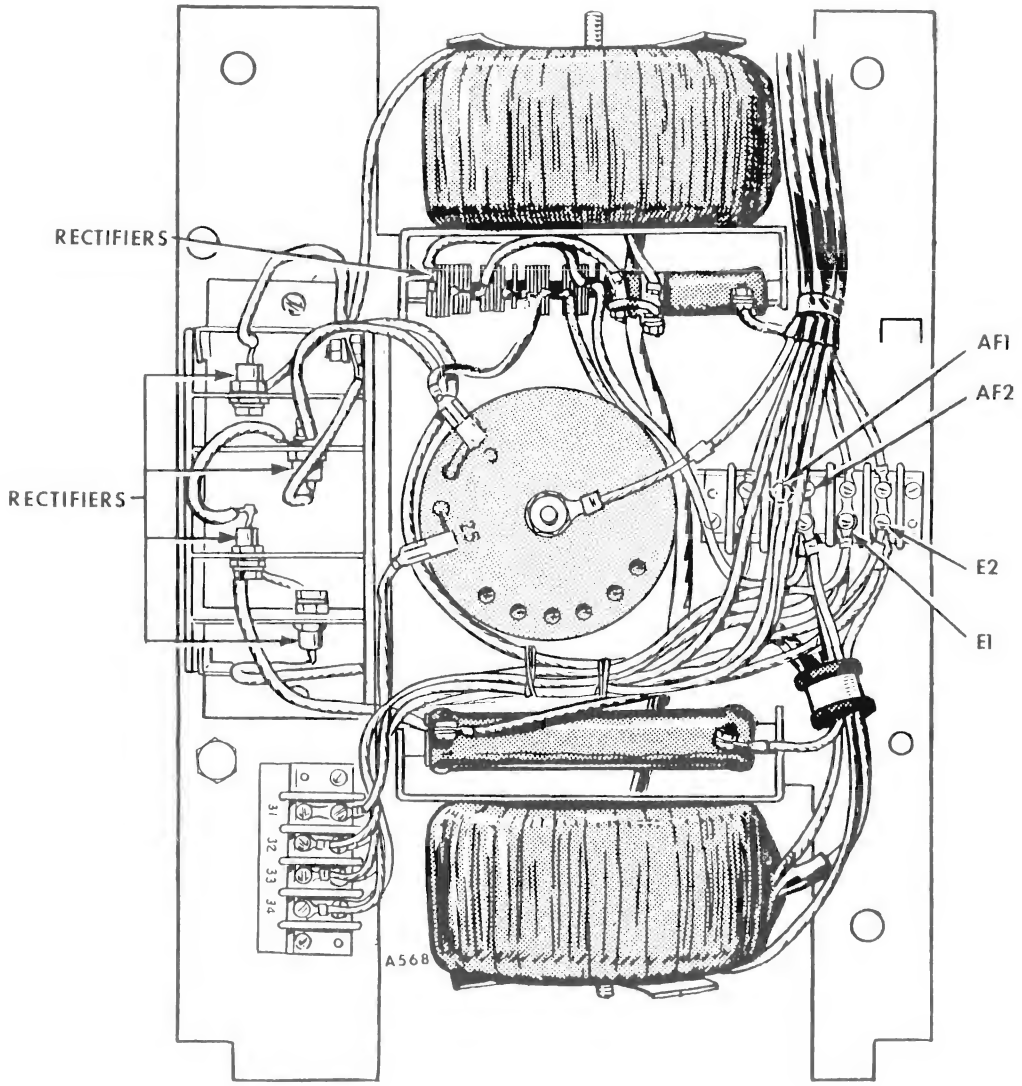
Generator Tests. - If the generator does not function properly, a few simple tests may isolate the cause.

1. Check AC voltage at E1-E2 with the plant operating. Voltage should be five percent of the rated voltage. If not, check continuity from E1-E2 back to the generator.

If there is no dc voltage across terminals AF1 (+) and AF2 (—), the exciter is not functioning.

2. If dc voltage at terminals AF1 and AF2 is 25 volts or higher (no load condition) but there is no ac output at the generator main output terminals, check the alternator for a grounded or open circuit, etc.

3. No terminal of the exciter should show a grounded circuit.



4. If ac voltage drops under load conditions, check the exciter rectifiers. Use a low voltage, battery powered "Multimeter" type ohmmeter. Disconnect one lead from, or remove, each rectifier for its test.

CAUTION

Note carefully the DIRECTION OF MOUNTING of any rectifier removed. It, or any replacement, must be remounted in its original direction.

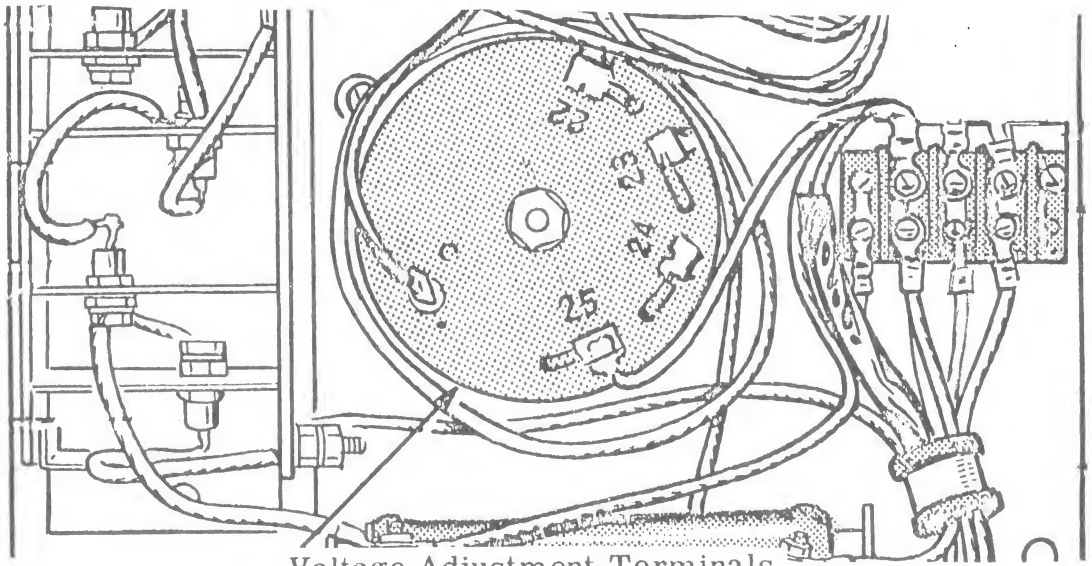
a. Connect the ohmmeter across the rectifier contacts and observe the meter reading.

b. Reverse the connections and compare the new reading with the first reading.

c. If one reading is considerably higher than the other reading, the rectifier can be considered satisfactory. However, if both readings are low, or if both show an "open" circuit, replace the rectifier with a new identical part.

5. If a hunting condition exists, which cannot be corrected by a governor sensitivity or a carburetor fuel mixture adjustment, check the adjustment of the stabilizing resistor in the static exciter for a value of 80 ohms. A resistance too low may be the cause.

Output Voltage (Models ending with spec. letter A, only). - The exciter was connected for rated output during the factory test run. Ordinarily if the engine is operating properly and at approximately the nameplate indicated speed, the generator output voltage will be correct. However, if some local condition requires a slight change in the voltage, change exciter connections.



Voltage Adjustment Terminals
Models ending with spec. letter A only.

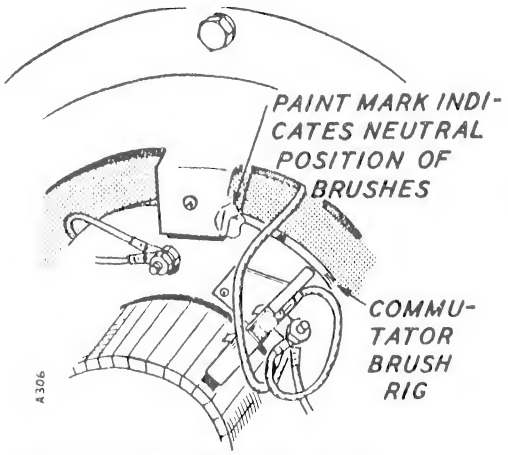
1. Be sure the engine is operating properly, and that the governor is properly adjusted for correct current frequency (speed), sensitivity, stability, etc.

2. Stop the plant and remove the exciter cover.

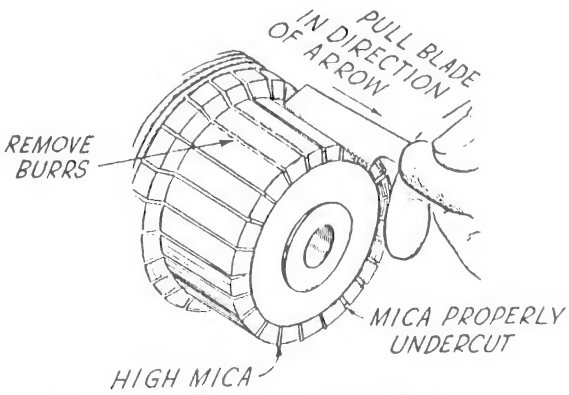
3. Note a disc shaped terminal block at the center, with a lead connected to a terminal marked C, and a second lead connected to one of the terminals marked 22, 23, 24 or 25. Moving the second lead to an adjacent terminal (from 25 to 24, etc.) will change the generator output approximately 5-percent.

ROTATING EXCITER. - The rotating exciter is a dc generator, used on units that do not have the separate automotive type starter and charging generator.

1. Commutator. - After a long period of service, the commutator surface may become worn level with the mica insulation between the bars. Undercut the mica to a depth of approximately 1/32-inch. Sandpaper off any burrs formed along the edges of the bars. DO NOT use emery or carborundum abrasives.



EXCITER BRUSH RIG ALIGNMENT



UNDERCUTTING MICA

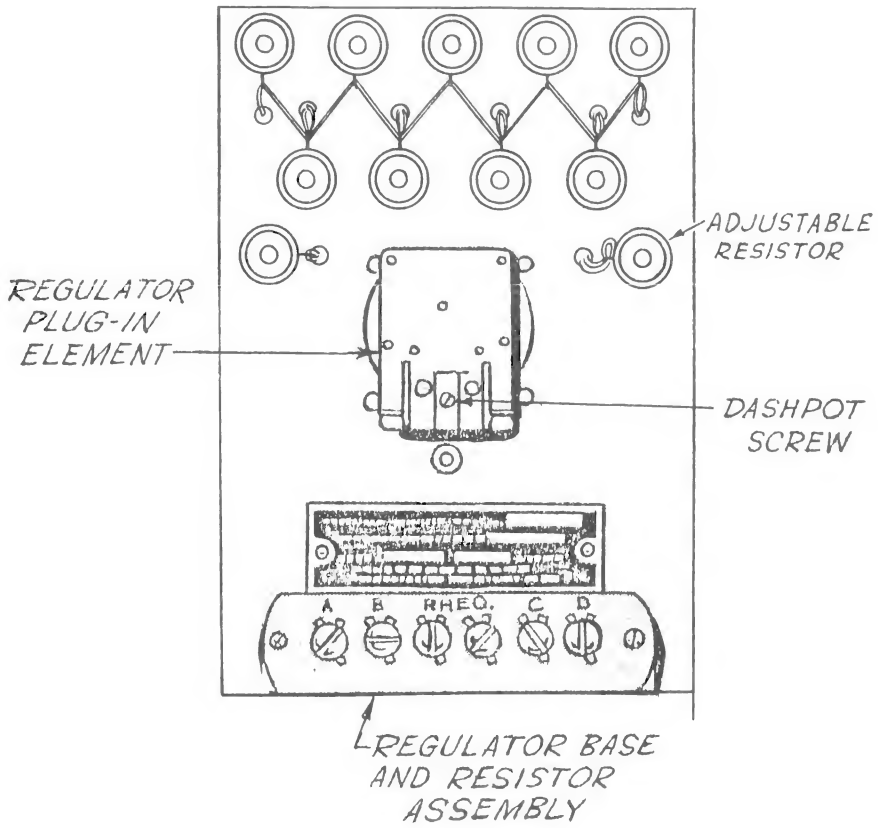
2. Exciter Brush Rig. - The exciter brush rig position is marked during the factory test run. If the brush rig position has been disturbed for any reason, it must be realigned. The correct position is indicated by a chisel mark on the outside edge of the insulating ring, which mark must align with the edge of the marked mounting boss inside the end bell.

VOLTAGE REGULATOR. - The voltage regulator is used only on those units that have the rotating exciter.. Except for keeping the regulator free of dust, etc., the regulator should require no maintenance. No cleaning or lubricating materials should be used.

If a new regulator or related part is installed, some adjustment may be necessary.

1. Be sure the exciter brush rig position is correct, to give its highest voltage. This must be done with the manual (field) rheostat in operation - regulator not in operation.

2. Turn the field rheostat to its extreme counterclockwise position, to switch in the voltage regulator.



Voltage Regulator

3. Observe the output voltage, which should be adjustable by use of the regulator rheostat, within a range of ten percent above and below the rated voltage.

4. If the regualtor rheostat does not permit the proper adjustment range, it may be necessary to adjust the regulator resistor. With the regulator rheostat at its center adjustment position, loosen and move the sliding clip on the adjustable resistor. Very little movement of the clip will be necessary to obtain the correct voltage.

5. If a fluctuating voltage condition exists only when the voltage regulator is in operation, but voltage is steady when regulated by the field rheostat, adjust the regulator dash pot screw. After removing the clamping bar holding the plug in unit in place, remove the screws holding the cover can. Turn the slotted screw at the center slightly until the fluctuating voltage condition just stops.

CAUTION

Do not attempt any other regulator adjustments. Never change the original settings of the regulator springs or contact fingers.